AWOP News

Area-Wide Optimization Program

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Total System Optimization – How does it relate to AWOP?

Background

"Total system optimization" is a phrase familiar to the drinking water profession, but probably has taken on several meanings over the course of time. EPA's drinking water treatment optimization program utilizes the Total System Optimization (TSO) phrase to describe the simultaneous achievement of all treatment goals adopted by an optimized water system. It is a concept that has played a progressively greater role during development and demonstration of the Area-Wide Optimization Program (AWOP). Initially focused on turbidity removal through implementation of AWOP components and effective application of optimization tools such as the Composite Correction Program (CCP), the scope of AWOP has now been expanded beyond optimization of treatment for microbial pathogens. The scope of AWOP now includes additional public health priorities, such as disinfection byproducts (DBPs), and addresses issues of conflicting treatment objectives as they begin to emerge.

EPA's optimization program formed a TSO workgroup as the "developmental arm" of the national drinking water optimization program with the intent that the TSO products/materials can be "plugged into" the existing AWOPs (as appropriate). The anticipated treatment challenges from more stringent DBP regulations (for both large and small water systems) and simultaneous compliance concerns motivated the optimization team to first focus on approaches to achieve optimal reductions in DBPs, while also achieving optimal levels of turbidity removal. Future TSO development activities will likely focus on other treatment

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Monitoring – The Key to Minimizing DBP Formation

As with turbidity optimization, optimizing water systems to control DBP formation relies greatly on the data that the water systems are able to provide. However, unlike turbidity, where water systems will have multiple turbidity readings per minute from on-line turbidimeters, many water systems only have the required monitoring results for TOC samples (monthly) and DBPs (quarterly). DBP optimization typically requires additional monitoring for DBP precursors and DBPs as the lack of data can make it difficult to assess the impact of DBP control strategies on DBP formation.

To account for the possible lack of data, the DBP optimization goals include both performance and monitoring goals. For all DBP optimization activities, finished water DBP monitoring is recommended as frequently as is feasible (i.e., every 2 weeks, or at least monthly). Additionally, monthly distribution system DBP monitoring is recommended at the system's DBP compliance monitoring locations AND at areas in the distribution system that potentially have high water age.

The data from the above monitoring is needed to help water systems in their optimization efforts. TOC monitoring is needed to assess changing raw water TOC concentrations (i.e., help plant staff anticipate the need for a coagulant dose change to maintain good TOC removal) and also to assess the impact of a TOC removal DBP

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areas and contaminants, and may provide a more extensive assessment of source waters and distribution systems. This article presents a brief history of the TSO development activities and demonstration of associated optimization tools. TSO activities have historically been undertaken in Region 4 and 6 AWOPs, but may ultimately be expanded into other Regional AWOPs.

To define the problem, we went to the source … and the distribution system.

Initially the TSO development activities focused on drafting a Disinfectant/Disinfection Byproduct Comprehensive Performance Evaluation (D/DBP CPE) protocol. Simultaneous compliance concerns (i.e., not compromising other important treatment objectives, such as meeting the optimized turbidity performance goals, at the expense of DBP control) were of great concern to the workgroup, and the D/DBP CPE protocol needed to reflect this. Similar to the microbial CPE protocol, the workgroup adopted disinfection and DBP performance goals that are more stringent than the current regulatory requirements. Additionally, spreadsheets to assess system performance relative to the goals were developed, potential special studies to assess performance limiting factors were identified, and performance limiting factors were drafted. The workgroup quickly recognized that the D/DBP CPE needed to include an evaluation of distribution system performance. Additionally, field methods for DBPs and DBP precursors needed to be identified and their potential application for process control monitoring had to be assessed (See companion article in this issue of the newsletter for more information about potential field methods that could be used for long-term monitoring needed for DBP optimization). Also, at that time the concept of optimizing water systems to control DBPs was relatively new, so the D/DBP CPE protocol includes a process for identifying DBP control strategies and potential secondary impacts related to implementing each strategy. Finally, the workgroup identified the need to develop a method for determining a water system's potential capability to meet the D/DBP performance goals (analogous to a Major Unit Process Evaluation during a turbidity CPE). This component of the D/DBP CPE is still under development and is, perhaps, one of the most challenging tasks in the development of the D/DBP CPE protocol. The state and EPA regional AWOP partners from Regions 4 and 6 participated in the developmental efforts. Once the D/DBP CPE protocol was fairly well defined, formal D/DBP CPE training was conducted through a series of three 1½ day workshops. This training culminated in pulling together the knowledge gained from the workshops into the performance of multi-state D/DBP CPEs in Region 4 and 6 in early 2004.

Now that we better understand the problem, what's next?

Once the D/DBP CPE protocol began to take shape, other TSO developmental activities were initiated to support the AWOP model (see figure). Development of a DBP Status component was critical for states to prioritize their systems and resources for D/DBP optimization activities. The TSO workgroup developed example DBP Status Component Ranking Criteria, which considers both the performance of water systems (relative to the DBP performance goals) and a system's potential to optimize to control for DBPs. Several AWOP states have developed their own DBP Status components to prioritize their systems (relative the D/DBP optimization performance goals) and focus their optimization (and technical assistance) efforts.

In response to feedback from AWOP states on DBP variability and associated compliance concerns, the TSO workgroup is currently reevaluating the DBP optimization performance goals and pursuing an approach to setting goals that considers variability in measured DBP concentrations. This process has examined DBP data from over 100 water systems in three AWOP states with several years of historical data. The outcome of this analysis will likely yield revised DBP optimization performance goals and may change the

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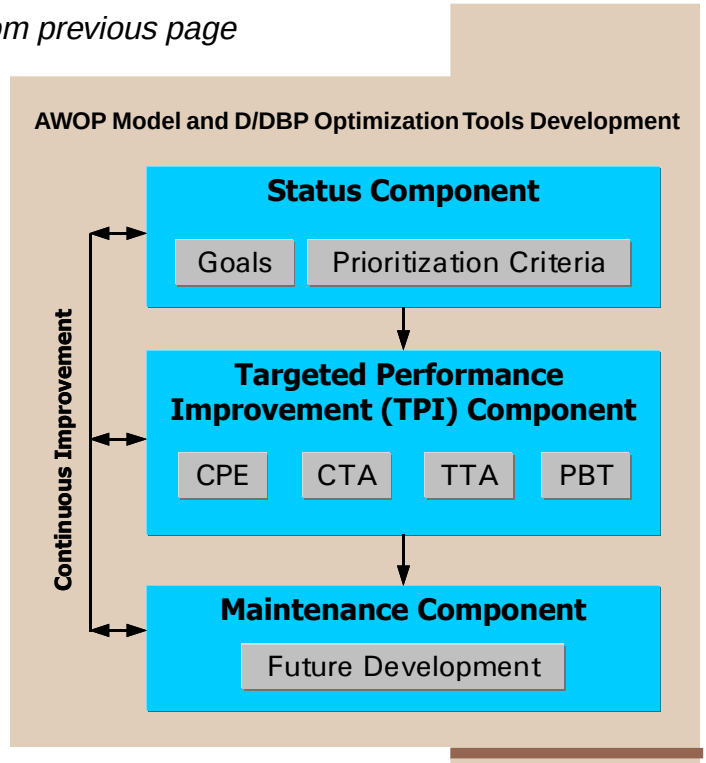
approach the AWOPs use to assess system performance relative to the DBP optimization performance goals.

To further the development of DBP field experience, several Comprehensive Technical Assistance (CTA) efforts were initiated. These CTAs provided the TSO workgroup the opportunity to work with water systems to implement the DBP control strategies and address the performance limiting factors that were identified during D/DBP CPEs. These CTAs have highlighted some of the significant secondary impacts associated with implementing DBP control strategies and important simultaneous treatment issues (e.g., balancing manganese removal with DBP reduction, maintaining the disinfection barrier in distribution systems). Field DBP and DBP surrogate methods have been evaluated during the CTAs, as well as bench- and full-scale special studies to assess the potential impact of implementing the DBP control strategies. In accordance with the core optimization philosophies, all DBP control strategies have been implemented by the water system operators using the special study approach (i.e., focus on developing a study that includes monitoring and gradual change in operations to achieve the desired result). These CTAs are ongoing at several water systems.



CTAs sound great, but our systems need to be in compliance – and quickly!

With the Stage 1 D/DBP Rule impacting large and small systems beginning in 2004, many AWOP states have recently had to shift their focus from meeting optimized DBP performance goals (which are more stringent than the regulations) to helping their water systems comply with this regulation. To leverage their resources, many states tried a workshop approach of providing technical assistance (i.e., work with multiple systems during one training session), but found that many of the water systems that were still having DBP problems might need one-on-one technical assistance. As a result, the TSO workgroup revised the D/DBP CPE materials and some of the approaches used during the D/DBP CTAs, and repackaged these into a Targeted Technical Assistance (TTA) protocol. The TSO workgroup recognized the departure of this compliance tool from the comprehensive approach to optimization embodied in AWOP. However, the TTA protocol follows many of the AWOP principles such as optimizing the existing water system (rather than emphasizing plant design modifications), having a strong focus on data collection to assess the problem, monitoring performance improvements and secondary impacts, and using the special study approach to implement DBP control strategies. The TTA approach was piloted in Oklahoma in October 2004, and then demonstrated at the Region 6 AWOP meeting in January 2005. This new tool will be demonstrated at the Region 4 AWOP meeting in April 2005. The Region 4 and 6 AWOP states will be encouraged to implement a TTA project with at least one of their own water systems to gain experience with the protocol.

The development of a Performance Based Training (PBT) series for D/DBP optimization and control is planned. It is anticipated that the original PBT model for turbidity optimization will be modified, so that the D/DBP PBT series will likely include 3 to 5 sessions, with its primary focus being D/DBP control. Development and demonstration of this PBT series will result in a full complement of D/DBP "tools" being available to the AWOP states and Regions: CPE for identifying performance limiting factors, CTA and PBT for long-term sustained improvement, and TTA for short-term compliance assistance.

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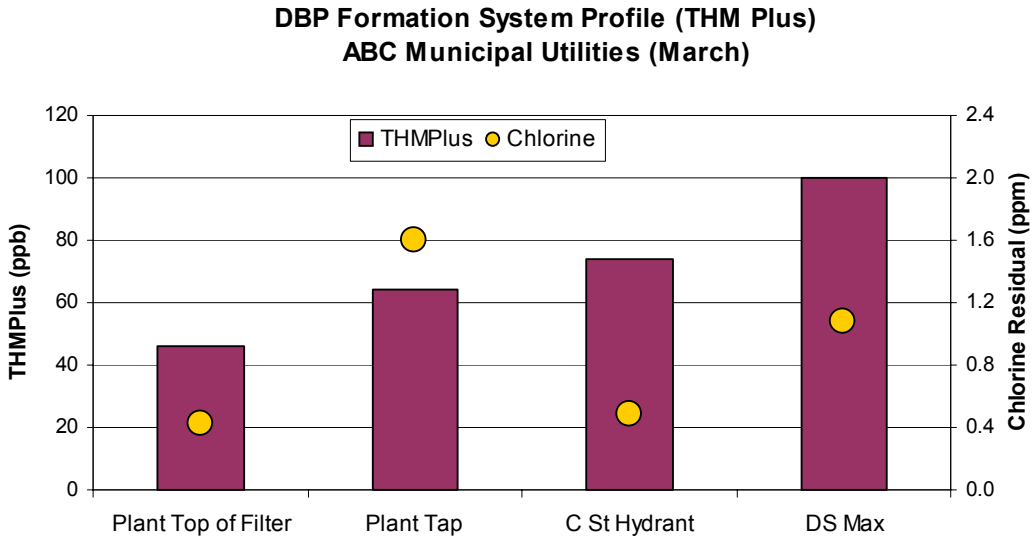
control strategy. Therefore, it is recommended that monitoring (i.e., TOC, alkalinity, and pH) be done during periods of changing raw water quality (e.g., due to weather, lake turnover, etc.), in addition to the monthly monitoring of raw and treated water TOC, as required for many water systems by the Stage 1 D/DBP Rule.

Unfortunately, very few systems have the instrumentation needed to analyze TOC, TTHM, and HAA samples and the cost of sending the samples to a lab for analysis can be significant, especially for small systems. Additionally, many labs require several weeks to analyze the samples and provide the results, making it challenging to use the results for real-time process control.

Due to these concerns and the need for timely data when pursuing DBP optimization, the TSO workgroup and several AWOP States have evaluated several field methods that can potentially be used as TOC and TTHM surrogates. Ultraviolet Absorbance at a wavelength of 254 nm (UV_{254}) can sometimes be correlated with the amount of organic matter (e.g., TOC) in a water sample. UV_{254} can be measured on-site in any lab that has a spectrophotometer capable of measuring in the ultraviolet light range. Given the ease of sample measurement and the relatively low cost of analysis, UV_{254} is an attractive surrogate for monitoring organics levels in water samples. However, there are some limitations with using UV_{254} as a TOC surrogate, and factors such as oxidation, chemical treatment, and seasonal changes in water quality can impact the relationship between a water's UV_{254} absorbance and TOC concentration. In other words, the UV_{254}:TOC correlation will likely be different for raw and treated water, and may even vary as raw water quality changes (due to seasonal impacts, weather-related factors, etc.). For more information on UV_{254} analysis, please refer to Standard Method 5910 (UV-Absorbing Organic Constituents).



One field method that has been evaluated for estimating DBP concentrations is the THM Plus method (developed by HACH). As the method name suggests, this method quantifies TTHM *plus* several other DBPs, including several HAA species. Thus, this method cannot be used for compliance monitoring, but it can potentially be used as a process monitoring tool to estimate the magnitude of DBP formation and the impact of DBP control strategies on finished water and distribution system DBP concentrations. An example of this is shown in the figure above, where THM Plus was used to develop a DBP and chlorine residual profile for this water system. This profile shows the relative amount of DBP formation in the plant,

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and then out into the distribution system (at the hydrant and at the system's assumed distribution maximum residence time location). Data from other work with this water system indicates that the average THM Plus:TTHM ratio for this water system is 1.4 (i.e., THM Plus of 140 ppb TTHM of 100 ppb), but ranged from 1.0 to 2.1 for these samples. This range of TTHM:THM Plus correlation suggests that multiple paired TTHM/THM Plus samples should be collected as a water system works to develop its TTHM:THM Plus ratio. Understanding the relative amount of DBP formation in the plant is critical to knowing where to target DBP control strategies (i.e., in-plant or distribution system). Additionally, as a DBP control strategy is implemented, periodic monitoring is needed to quantify the impact of the strategy on water quality. Thus, despite the variability in this method, this *type* of field method makes increased monitoring feasible and provides real-time feedback to water systems pursuing DBP optimization and control. More information about the THM Plus method can be found at www.hach.com.

Overall, process control monitoring of DBP precursors and DBPs is critical to DBP optimization. For more information about this work please contact Alison Dugan at dugan.alison@epa.gov or (513) 569-7122 or Larry DeMers at LDemersCO@aol.com or (970) 223-5787. ■

What's New on the AWOP Web Page

The following Powerpoint presentations have been posted to the new AWOP page on the new ASDWA web site (http://asdwa.citysoft.com/awop). Both presentations were delivered at ASDWA's fall 2004 Conference in Austin, Texas. A brief overview of each presentation follows:

- **"Incorporating AWOP and the Partnership into Your Everyday Work"** (Phil Consonery; Pennsylvania Department of Environmental Protection): This presentation begins with historical background on the importance of optimization activities in the commonwealth in the light of waterborne disease outbreaks between 1971 and 1985. The state's efforts to evaluate filter plant performance for surface water facilities are next explained. The state's various initiatives associated with both the Partnership for Safe Water and the Area Wide Optimization are then reviewed, together with a summary of performance data demonstrating tangible benefits of the programs. The presentation concludes by summarizing the ways that the Partnership program and AWOP can improve the daily work of state personnel.

- **"Arkansas' Use of Optimization for Meeting Regulations"** (Mark McIntosh, Arkansas Department of Health): This presentation begins by summarizing the results of pre-optimization DBP levels at water systems throughout the state. The results of DBP optimization efforts over a five year period – a dramatic lowering of DBP levels at several facilities – are then presented. The presentation notes how a hands-on approach to providing technical assistance by state optimization personnel has changed perceptions among utility personnel and created a greater receptivity to participating in the AWOP program. ■

Do You Have Something to Add?

If you have an idea for a newsletter article or materials to add to the AWOP web page, please contact Jim Taft at jtaft@asdwa.org. Further, if you would like to subscribe to AWOP News, and are not currently on the mailing list, please contact Anthony DeRosa at aderosa@asdwa.org. ■

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We've come a long way, but there's more work to do!

In summary, the TSO development activities have historically focused on DBP control and this process has been long, sometimes frustrating, but always exciting. The Region 4 and 6 AWOPs have provided great opportunities for the developmental field work, feedback on the D/DBP protocols based on their experiences, and ideas for the TSO workgroup to further refine. We still struggle with several issues — not only with materials development but also on exactly how the DBP optimization activities fit with the existing turbidity optimization program. For example, issues such as how to deal with having both turbidity and DBP status components, and whether turbidity or DBP optimization activities should take precedence in a State program, can be difficult. Nonetheless, the TSO workgroup continually assesses future areas of interest and how they can add value to the Regional AWOPs. Future areas for the TSO workgroup's short-term focus will be on furthering our understanding of optimizing distribution systems operations to control DBP formation. And, as we gain a better understanding of optimizing water systems to control DBPs the TSO workgroup will likely shift its focus to other treatment concerns and potential programmatic ties with optimization (e.g., groundwater optimization, source water protection, operator training, and capacity development). For more information about the D/DBP optimization work, please contact Alison Dugan at dugan.alison@epa.gov or (513) 569-7122 or Larry DeMers at LDemersCO@aol.com or (970) 223-5787. ■

AWOP Quarterly Meeting Update – February 2005

One of the key components of a multi-state area-wide optimization program (AWOP) is the quarterly meeting held between participating state program personnel, EPA, ASDWA, and the contractor, Process Applications, Inc. These meetings are part of the strategic implementation process used to sustain the AWOP partnerships and activities. The meetings accomplish multiple objectives including sharing ideas, agreeing on direction and priorities, providing multi-state support and encouragement to improve program performance, and sharing technical and management information and approaches. Each of the four Regional AWOP Programs held meetings since the last issue of AWOP News in October, 2004

Region 3 held a quarterly meeting in Harrisburg, Pennsylvania in October. The meeting utilized the typical quarterly meeting format. A variety of issues were discussed and action items were established. The topic of integrating water program activities into AWOP thinking and efforts was introduced. Participants were requested to develop ideas using the "topic development sheet format" on one state program or resource where they felt that they could integrate AWOP thinking and activities into their efforts so that it would complement AWOP impacts. The states were requested to plan to make a presentation of their assessment and, if feasible, any activities completed at the next quarterly meeting. The next meeting is scheduled for March 2005. Anticipated topics to be discussed and assessed for development at the March meeting are Performance Based Training (PBT), disinfection byproduct (DBP) control and optimization, and development of annual reports.

The Region 4 meeting was held in November in Frankfort, Kentucky. During the previous quarterly meeting, a demonstration of jar test calibration techniques had been completed. The participants were requested to implement jar test calibration techniques in their state and to report back on these activities. The reports were completed as a portion of the quarterly meeting. An approach to calibrating a jar test for the Actiflo unit process was also presented. The participants felt that the jar test calibration activities were valuable in enhancing their operations and training expertise. A regular quarterly meeting was held and activities and assignment for the next quarter were established.

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AWOP Quarterly Meeting Update*...continued from previous page*

Region 6 combined a field-training event with their scheduled quarterly meeting held in Texarkana, Arkansas in January. The field training activity demonstrated the Targeted Technical Assistance (TTA) approach. As described in more detail in this newsletter, the TTA approach consists of activities that lead to special studies that support operational changes to water systems that are challenged with meeting the Stage 1 D/DBP Rule requirements. Water systems that will most benefit from this technical assistance include those that have flexibility to make process changes and minor modifications and do not exceed the Stage 1 D/DBP rule requirements by more than approximately 20 percent (i.e., TTHM < 96 mg/L; HAA5 < 72 mg/L). These values are only presented as a guideline. If water systems are still practicing prechlorination or have not achieved TOC removal required by enhanced coagulation and have DBP values higher than these guidelines, there is good potential to optimize these systems. This protocol was developed assuming the providers of the DBP TTA have an understanding of D/DBP optimization concepts and skills as received through previous training conducted as part of AWOP. This training for AWOP participants included three 1 ½ days sessions and one D/DBP CPE. The TTA is a diversion from facilitated transfer of skills, which is the focus of PBT. The TTA was developed to assist AWOP participants with anticipated noncompliance issues associated with DBPs. The TTA demonstration was conducted at the Little River County Rural Water System located near Texarkana, Arkansas. A regular quarterly meeting was conducted following the demonstration.

Region 10 initiated PBT in November by holding Session 1 in Lewiston, Idaho. Eight utilities are participating in the Idaho PBT and Idaho, Region 10 and the Alaska Technical Training Assistance Center personnel are participating as facilitators for the training. Oregon and Washington have been invited to attend the training to gain perspectives on the PBT approach. The next training event (Session 2) is scheduled in March and will be conducted at the Weiser, Idaho water treatment facility. If Oregon and Washington are able to attend, an AWOP quarterly meeting will be conducted.

Recent and future activities are as follows:

Date	Activity
Week of February 28, 2005	Region 10 PBT Session 2 and Quarterly Meeting – Weiser, ID
Week of March 8, 2005	Region 3 Quarterly Meeting – Martinsburg, WV
Week of April 18, 2005	Region 4 TTA Demonstration and Quarterly Meeting – Georgia
Week of May 9, 2005	Region 6 Quarterly Meeting – NM
Week of May 23, 2005	Region 10 PBT Session 3 - ID
Week of July 18, 2005	Region 4 Quarterly Meeting – GA
Week of September 5, 2005	Region 10 PBT Session 4 – ID
Week of October 17, 2005	Region 3 Quarterly Meeting — VA
Week of November 14, 2005	Region 4 Quarterly Meeting – Alabama
Week of November 28, 2005	Region 6 Quarterly Meeting – TX
Week of December 5, 2005	Region 10 PBT Session 5 - ID